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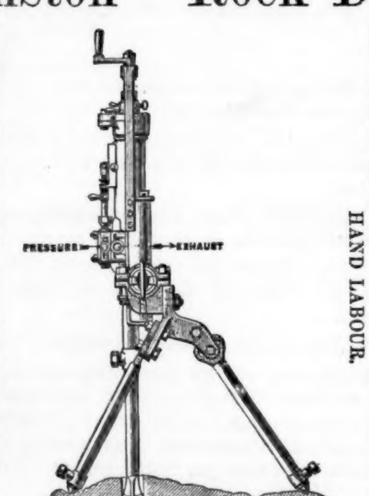

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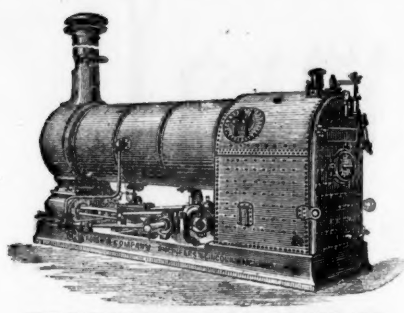

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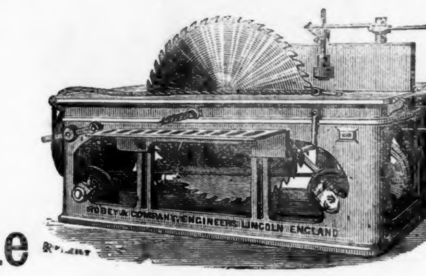

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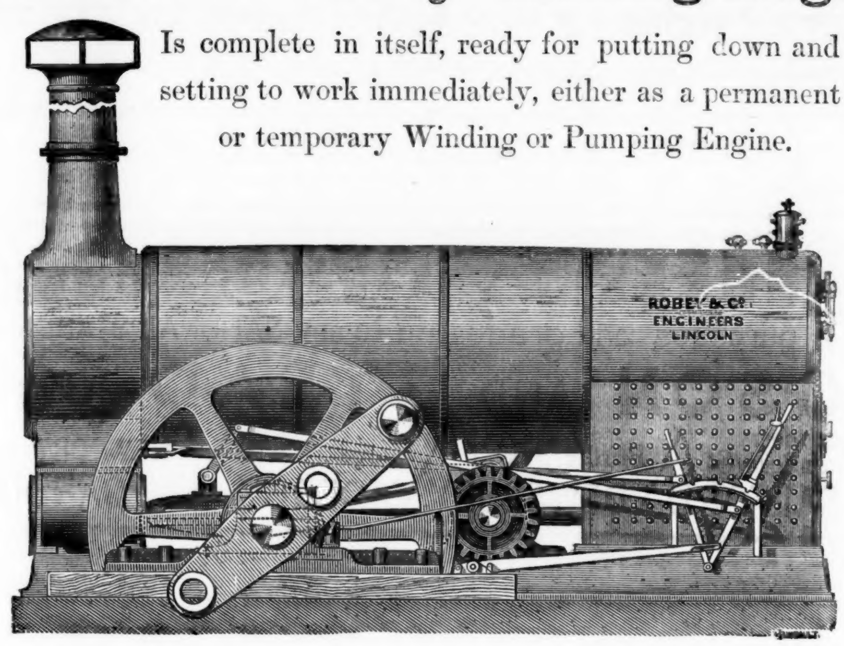

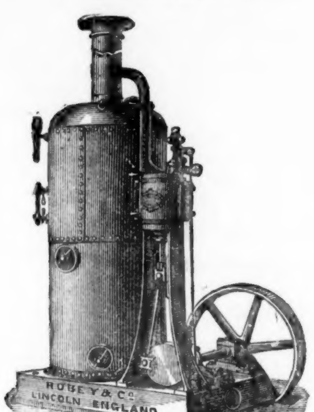

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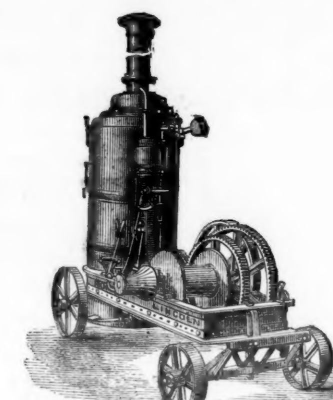

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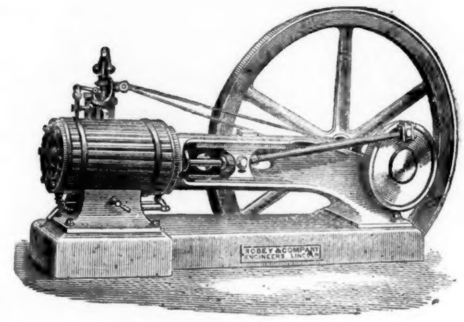

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8.—Very much greater economy in subsequent repairs as compared with gearing.

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CLAUSTHAL MINING SCHOOL NOTES*—No. CXLII.

BY J. CLARK JEFFERSON, A.R.S.M., WH. SC.,
Mining Engineer, Wakefield.
(Formerly Student at the Royal Bergakademie, Clausthal.)

METHODS OF WORKING WITHOUT ATTLE PACKING.

STALL WORKING.—This method of working may, perhaps, be considered, as we have before mentioned, as that from which pillar working is derived. The oldest method, and consequently the rudest and most imperfect, of getting stratified deposits is that which we shall describe as excavation workings, in which the deposit is worked out in an irregular manner, in chambers irregularly arranged, the chambers being excavated to the greatest extent possible without the breaking in of the roof. When the workings were carried on more rationally some definite system would be arranged, and its most systimatic development by making the workings to consist of roadways or stalls driven at right angles to each other constitutes the method of working called stall working.

The distinguishing characteristic of this method is the systematic sacrifice of a portion as pillars which are intended to be left, either to avoid the expense of other materials for supporting the roof during the working out of the deposit, or to keep up the roof altogether, in the latter case with the object of preventing damage to the surface or buildings, or to protect the mine from irruption of water, which in some cases (such as those of salt deposits) would be fatal to the mine. Generally this method of working is adopted and arranged without any intention of weakening the pillars after they are once formed, though in coal mines the partial working away of the pillars is often attempted, but it should always be considered best to err on the side of making the pillars too large than too small.

The inclination of the deposit is, perhaps, the most important factor in determining the particular mode of arranging the pillars. Where the inclination of the deposit is considerable the pillars have a tendency to slide downwards, so that in such a case it is usual to arrange the pillars in the dip line, by driving the inclined roads, or stalls, on the full dip of the seam, which are made larger than the horizont stalls, or levels. In order still further to obviate the risk of the pillars sliding the levels between the pillars are packed tight with debris. When the inclination is slight the so called chessboard arrangement is that which keeps up the roof best, as none of the spaces in the stalls where the roof can break down are so great as in the other system. By this method of working, where only one-half or two-thirds of the deposit is got, as is usual in many coal mines that are worked under conditions necessitating the keeping up of the roof unbroken. In some of the Westphalian mines working under the bed of the River Ruhr only one-half of the coal is got, the rest being left as pillars. In this case the pillars are left somewhat wider across the dip than on the line of it. When working salt deposits a much less proportion is required to be left as pillars. In working the salt deposits in Cheshire, which are 15 in. thick, the usual arrangement is that first mentioned, the stalls, however, being 25 yards wide, and the pillars only 6 yards square, so that about 6 per cent. only of the deposit is left. In one or two of the mines in the district an enlarged chessboard is adopted, the levels being driven 8 yards wide, with 8-yard pillars between, and these intersected by inclined roads 21 yards wide, with 8-yard pillars between them.

The winning of the immense salt deposits at Stassfurt is effected by stall working. The deposit, which has a dip of 30°, is composed of two principal layers—an upper one of potash salts and the lower of common rock salt. The deposit is reached by two shafts (160 lachters) about 350 yards deep, near the upper portion of the rock salt deposit, and, consequently, also in the level of the lower portion of the potash salt beds. The two shafts are situated 23 yards from each other in a north-westerly direction. The rock salt deposit is worked from the more easterly situated shaft, and the potash salt deposit from the other. From the east shaft a cross-cut or level is driven in the rock salt deposit at right angles to the strike towards the floor, or lying side of the deposit, which, however, has not yet been reached, owing to the immense thickness of the deposit. In a similar manner the potash salt deposit is opened out by a cross-cut from the west shaft, driven towards the roof or hanging side of the deposit. At a distance of about (18 lachters) 40 yards from the east shaft a pair of levels are driven north and south parallel to the strike of the deposit, and on both sides of the cross-cut in the lying or rock salt portion of the deposit. At a distance of (60 lachters) about 135 yards from the pair of levels a second level is driven parallel to them, and other parallel levels will be set off as the cross-cut advances. The large pillars thus formed are cut across by the stalls, which were at first driven (4 lachters) 9 yards wide, with pillars left between (3 lachters) about 7 yards thick. The height of the stalls and the levels is 4 lachters; these are driven forward in two stopes of (2 lachters) about 4½ yards in height, the lower stope being driven first. The working faces of the stalls and levels form an overstope, consisting of two stopes of 4½ yards each. A larger get of salt from a given area, with an accompanying diminution of the expense of getting, was obtained by making the stalls from (11 to 12 lachters) 25 to 28 yards wide, and leaving the pillars (6 lachters) about 14 yards thick, the height of the stalls remaining the same—9 yards.

The hanging or potash salt portion of the deposit is opened out by a cross-cut from the west shaft driven to the roof or hanging wall of the deposit. At a distance of (15 lachters) about 35 yards from the marl on the hanging side of the deposit, the potash salt deposit is covered off on the lying side by a main level driven north and south parallel to the strike. This main level is continued forward to open out this portion of the deposit to the full extent in the direction of the strike. From this main level the stalls are driven forward towards the roof (4 lachters) 9 yards in width and height, leaving 7 yards of pillars between them. In consequence of the broken or breakable nature of the potash salt the stalls cannot be enlarged above this size to any pecuniary advantage.

STOCKWORKS.—The general character of those mineral deposits, which are usually called by their German name "Stockwerke," have been already described at the beginning of these lecture notes. Such deposits receive their name from the general arrangements of the chambers or excavations, out of which the mineral is obtained, which is somewhat similar to the arrangement of the rooms in a house in stories. The excavatians made are more or less regularly arranged, according to which two distinctions are made by Lottner, the more regular being called "Weitungsbau" (excavation workings), and the less regular "Stockwerksbau;" there is, however, no definite difference, as will be seen from the following examples, the first of which is an example of "Stockwerksbau." The formation of such large empty spaces, which are intended to remain open after their abandonment, requires that the deposits in which these two methods of working are adopted shall be of a strong and compact character, since in many even favourable cases these excavations have broken down, several running into one, and, as may be easily imagined, with dangerous and fatal results.

As an example of what is termed stockworks, that of the tin deposits at Altenberg follows. This deposits, according to Von Cotta, consists of a peculiar mass of rock of great thickness and irregular in form, and appears the result of volcanic eruption, though its limit is not very sharply defined, against the surrounding granite and quartz and syenite porphyry. In this mass of rock the tinstone is so finely divided that it is seldom seen or noticed as tinstone. The mass of the rock consists principally of quartz, impregnated with chlorite, talc, and tinstone. The upper portion of the deposit has been worked from shafts sunk in the deposit itself, but since the extension of the excavations a new vertical shaft has been sunk in the rock outside the deposit, so as to be unaffected by the breaking up of the ground where the deposit has been worked. From this shaft levels are driven every (10 lachters) 66 ft. into the deposit. When the level has reached the deposit cross-cuts are driven right and left in the deposit for the purpose of exploration—to find the most valuable portions of the deposit in which the excavations are made; the less valuable portions are intended to be left as walls or pillars. When a suitable place has been found for commencing an excavation the ground is worked outwards on all sides in an approximately circular form and upwards, the roof being kept more or less arched. The diameter of the excavations is kept under 14 yards to 18 yards as extreme. The height of the excavations is from 14 yards to 17 yards—so that from 10 ft. to 14 ft. of the ground is left up as a roof beneath the floor of the next storey or "stock" of chambers. The arrangement of the excavations in plan is generally irregular, since the points at which they are commenced depend on the amount of tinstone, which is more or less irregular in quantity. Formerly the ground was got by fire-setting, but at present entirely by blasting. When one storey has been worked out the levels from the next cross-cut, 66 ft. deeper, have been completed, and the positions in which the excavations in this lower storey are to be started will be chosen. In doing this it is endeavoured to make them coincide in plan more or less with the storey above—an excavation will be started as near as possible beneath an excavation in the pillar above, so as to leave a solid pillar immediately beneath a pillar in the storey above. It is of the greatest importance to prevent the ground breaking up, so that in no case shall the foot of a pillar in an upper storey rest directly over an excavation in the storey immediately below; since there is then the greatest danger of the roof giving way. As above mentioned it is impossible to make the excavations and pillars correspond exactly, but the deviations are kept as small as possible. As the workings extend it is impossible entirely to avoid the breaking in of the ground sooner or later, especially when, as at Altenberg, the deposit is of considerable thickness.

* Being Notes on a Course of Lectures on Mining, delivered by Herr Bergrath Dr. VON GRODDECK, Director of the Royal Bergakademie, Clausthal, The Harz, North Germany.

THE SYDNEY INTERNATIONAL EXHIBITION.—No. IV.

[FROM OUR SYDNEY CORRESPONDENT.]

Considerable inconvenience is felt by the delay which has taken place in the issue of the official catalogue which it now appears will not be ready before the first or second week in December. The total number of visitors now reaches from 6000 to 6500 daily, which, considering the population, is very satisfactory. The official dinner given last week by Mr. P. A. Jennings, C.M.G., the Executive Commissioner, was a great success, the various ministers, and I believe the commissioners, without a single exception, were present. There was an idea entertained that an effort would be made to open the exhibition on Sundays, but the feeling opposed to it has been so strongly and so widely expressed that it is improbable that any further movement in the matter will be made.

In the New South Wales Court the exhibits of Messrs. Moss and Co., the well-known importers of Wynyard-square, and of Mr. G. F. Law, the hatter, of George-street, are both worthy of notice, but I must pass them by in order to come at once to the British Court, in which the readers of the *Mining Journal* will, no doubt, take greater interest. I must remark, however, that among the results of amateur ingenuity displayed in the New South Wales Court one of the most attractive and at the same time very interesting exhibits is that of Mr. E. S. Rowe, of Liverpool-street, Darlinghurst. It consists of a handsome case of tortoiseshell and wood carving. The tortoishell has been worked into nearly every description of decorative jewellery worn by ladies—with a degree of taste and fineness of execution not to be surpassed by the best professional artist. Among other delicately-carved objects perhaps the most likely to attract attention are a double picture-frame surmounted by a representation of the dome of the Garden Palace, enwreathed with designs of nearly every Australian flower and fruit, also a ladies' back comb, combining the Australian Coat of Arms in a wreath of ferns, and bearing an inscription of "International Exhibition, Sydney, 1879." In the centre of the case is a combined mirror and jewel casket, most beautifully executed in walnut and Tasmanian black wood. Too much praise cannot be accorded Mr. Rowe, as the whole of this work has been done by hand in his spare moments after leaving his business avocation of an evening.

The British Court is justly regarded as a credit to the Mother Country, and as complimentary to New South Wales, because it shows that the importance of the colony is fully appreciated by British manufacturers. The more closely the Court is examined the more favourable is the impression produced. The inspection will furthermore reveal that the British manufacturers have on this occasion sent out a class of goods with which the colony is altogether unacquainted, but which doubtless are likely in future to be largely imported. It is quite apparent, too, from these exhibits that notwithstanding the oft-repeated tale of England's manufacturing decline, the Mother Country keeps pace with the world in regard to manufactures, and turns out articles of as practical and of as artistic a character as are produced in any other quarter, and there is this one grand fact—the workmanship is unsurpassed. We have heard different from this during the last few years, and it is one of the most satisfactory features of our Exhibition that the English manufacturers, by the show they have made, have removed an impression that was by no means conducive to their interests. Our representative is indebted for a good deal of useful information on these points to Mr. Leedham Crowe, a representative member of a London firm, through whose instrumentality a good number of the oldest and most prominent manufacturers are represented; and we are glad to hear from him that the Exhibition, as far as new articles of English manufacture are concerned, is likely to be of great mutual benefit to the colony and the Mother Country. The business representatives, in this city, of the firms whose exhibits are now about to be described are Messrs. J. R. Cattell and Co., who have been thoughtful enough to have experienced and courteous persons on the spot to afford visitors every information about the exhibits. Messrs. Cattell and Co. represent about 60 English firms, and their exhibits, as described below, will be found worth inspection.

The Brownhills Pottery Company exhibit a rich and varied collection of their works, and among them are articles that have won great prominence for the firm at the world's great shows. There are half a dozen vases 30 in. or more in height of exquisite design and finish, the equal of which is not to be found in the Exhibition. There is a splendid collection of flower vases of quite a new pattern, fruit plates, dinner and tea sets, in which novelty of design and artistic skill vie for supremacy. Looking at some of the table articles, the ornamentation in gold is so rich and new that it is quite difficult to believe the art of the potter has so far advanced as thus to mould and embellish a piece of clay. The collection includes some very handsome hanging plates for the drawing-room, in which English rural scenery and poetic or historic scenes are shown with striking effectiveness. These are destined to become very popular, just as in the old country. The collection altogether is a striking one, and if we are to judge from what we have been long importing to this colony, there has lately been a wonderful improvement among British artizans. There is quite an artistic touch about the style and finish of the exhibits; the wants of the household are as well, if not better, met than before, and a much higher taste cultivated; and if, in this respect, the Brownhill Company stand on an equality with any other exhibitor in their line, they are before all others in the wonderful cheapness with which their articles are placed before the public.

An attractive display of chandeliers, wall lights, gas and paraffin globes, nearly all of which are of novel design and make, is exhibited by Messrs. Isaac Barnes and Co., of Birmingham. One of the specialities of the collection is the Albert globe, which includes an appliance near the gas burner by which a very considerable saving in the consumption of gas is ensured. The 18-light chandaliers are among the best specimens of glass manufacture we have seen. One of these was specially designed and constructed for this Exhibition in a few months by Mr. R. J. Barnes, son of the exhibitor. A valuable display of ornamental brass-work in the Queen Anne and mediæval styles is also made by Messrs. H. Green and Son, Cannon-street, London. The hall lamps are the richest we have seen, and there is a marked absence of business and gaudiness that often do duty for good workmanship. The lamps for reading desks and lecterns, and the varied church requirements, are quite of a superior style, the ornamentation being both rich and singularly appropriate. Some very handsome billiard lights, which have already caught the eye of the principal hotel-keepers here, are likewise shown. The pattern is altogether new. All the exhibits in this collection are well and prominently displayed, and have been very closely inspected by the manufacturing trade.

The world-wide fame of Sheffield has a splendid representation in the exhibits of steel of Askham Brothers; there can be no mistake that the exhibit is unsurpassed, and there is but few that have been more closely inspected. The material is pronounced by the most competent judges as of the very best. The American axes, for quality and depth of steel, can stand no comparison here. Were the English axe of the description indicated largely sent out here, its thorough adaptability to our requirements would be very soon proven; the axe has a larger eye than the American, admitting of a good strong handle, the very thing the bushmen want. Morticing axes, splendid rock-drills, millers' bills, hoes, &c., are shown here, of unsurpassed quality. The material is good, and the workmanship solid—the very distinguishing features of English work—and it is most satisfactory to find that the men of Sheffield have at last seen the expediency of looking to a good representation in the colony in these days of rapid American and European communication. Webster and Company, of Sunderland, the original patentees of wire rope, have a modest exhibit of their manufactures, which, on inspection, is found to be A1. Wire and hemp rope are shown in various sizes, and are without equal.

The show of hollow ware exhibited by Messrs. T. and C. Clark, of Wolverhampton, finds innumerable admirers. This firm it appears has long been famous for its enamelled ware and hollow ware generally, have sent to the International some of their choicest workmanship and latest improvements in manufacture, as regards colour of enamel and shape of utensils, that are to be found in the market. This firm guarantees both their patent enamelled and tin wares to be free from lead, arsenic, antimony, or any other deleterious material. The enamel is of the purest white, and the various kinds of pots, saucepans, boilers are exceedingly well shaped. Their patented doubled edge cover, which is a great improvement on the old japanned cover, is much stronger, although lighter; its edges being turned and doubled in there are no sharp or scratching parts, a great advantage to those who have to clean them; its appearance is nearly as good as the bright burnished cover, whilst the price is the same as the regular japanned cover. The firm also show some capital manger fittings of improved patterns worthy of attention from horse owners. A large bath on the right hand side of the section, and numbered 3078, is called the Paris shape, having a self-acting overflow, and thereby doing away with the brass overflow fittings. Brass taps are likewise dispensed with, the hot and cold water coming in through the enamelled grating at the foot. The bath on the other side is one of those usually in demand, fitted with brass taps for hot and coal water, with brass overflow and outlet. Both baths are nicely fitted up in mahogany frames. There is also a very excellent hip bath, made expressly for the colony. It is nicely enamelled and well fitted. The firm also exhibit a large quantity of what are known as sanitary goods, in which they have made great advances and improvements. They comprise lavatory basins, plug bowl basins, closet hoppers, closet syphons, French commodes, urinals, &c. Their enamelled steam-pans and boilers are much liked, the quality of the porcelain enamel, and its mode of manufacture, being very suitable for any purpose—even for chemical uses. Their wrought-iron enamelled ware has equal advantages, being entirely free from poisonous ingredients, with the advantage of being as light as the American agateware, and at the same time being white inside any dirt is more easily detected.

The tinned ware of this firm is well known, and in the exhibits of tinned-lined saucepans and kettles, as also some coal and round pots, the quality and shape of these are studied in the same way as those that are enamelled—their hinge-case, which is artistically arranged, shows samples of their best butts, patent butts, tariff butts, and new 250 butts; also Gothic hinges, American spring hinges, Parliament and French hinges, brass joint hinges, skew or rising butts, back flap and sable hinges, best broad and tariff broad butts, &c. On some of the other shelves are arranged various kinds of axle pulley-wheels and other paper goods. Their odd-work case, which is also arranged with much taste, but is unfortunately in a bad light, contains a great variety of side pulleys, signal pulleys, axle and frame-pulleys, door handles, lifting handles, revolving rings, charcoal box irons, sad and fine cast irons, iron castors, turn buttons, brass and iron door knockers, door escutcheons, and sash centres, draw and lifting handles, brackets and stirrups, hat and coat hooks, string holders, and string stand boxes, coffee mills and mincers, croquet-ball and mallet holders, umbrella stands and hooks, sausage machines, and Silvester's sadirons. Two handsome chess tables, enamelled on slate, are specially noticeable, and a new thing in "push latches," known as Wheeler's patent, Weston's patent self-sustaining rope pulley block, and Limbert's patent wagonette side-pulley, Wetherhed's patent chain blocks, Lambert's sack hoist, Weston's gin block, Hewitt and Goff's patent pulley block for rope, pear-shaped blocks, old and new pattern, with iron and brass sheaves, snatch blocks, roller for running beam, wrought blocks, &c. Unfortunately the light in this portion of the basement rendered it very difficult for Mr. B. O. Clark, who is in charge, to show all his exhibits to the best advantage; in a great measure this faulty light has been overcome by re-painting and re-arranging, but owing to the nature of the surrounding exhibits some of the firm's smaller goods are with difficulty seen properly.

But the exhibit which probably surpasses all others in the British Court is that of the Earl of Dudley. To him, "Old South Staffordshire," still the chief seat of the English iron trade, should be greatly indebted, for, through his agent—Mr. E. Fisher Smith—he has sent to the International a fine collection of exhibits of iron, which are to be seen in a capital position on the basement floor. It contains specimens representing the various qualities of iron manufactured at he Round Oak Ironworks, the property of Earl Dudley, in Staffordshire, and commences with what is known as the L.W.R.O. brand and quality as a basis, showing thence all the different progressions up to the highest quality of crystalline and Damascus gun iron. Within the handsome case prepared for their reception are bent and fractured samples of these various qualities, showing thereby what the iron is capable of standing either hot or cold, and how beautifully clean is the interior of the iron when broken. There are also rough and polished horse-shoes by Messrs. Guest and Co., of Dudley, and rivets showing the different tests the iron will stand, by Messrs. Holt Brothers, of Dudley. There is also an iron bar galvanised by Messrs. W. E. and R. G. Walker, of Dudley, and afterwards tied into a knot while cold, without showing any fracture in the iron or difference in the galvanised surface. There are bars of angle iron 6 in. by 6 in., reversed and doubled inwards, and then drifted out at one end, affording the best evidence of the tractable nature of these large bulks of iron. Similarly, a bar 1½ in. square has been drifted out to 12 in. in diameter.

The case also contains iron forged into the most curious and fantastic forms, all designed to show how exceedingly pliable it is, and into what extraordinary forms the blacksmith's skill may convert it, without any indication of yielding to fracture, while it will polish up and case-harden, as though it were made of steel. Some of the same quality of bars, 1½ in. square, after having been nicked top and sides, stood 300 blows with a 36 lb. sledge hammer before breaking open. Above the case, and suspended from a spiral bar, are five bars, intending to illustrate the various forms into which the larger sections of the iron can be tied or twisted. There is a 2 in. round bar turned down in the lathe, and afterwards tied cold, the knot being reduced to about 6 in. in diameter. There is also a double-headed rail, twisted up tight so as to resemble a corkscrew, so close are the twists. The other bars are 3 in. and 3½ in. diametr, tied into knots, each about 12 in. in diameter; while the fifth is a 6 in. angle bar twisted similarly to the double-headed rail previously mentioned, the ends being reversed and doubled in. All these operations (with the exception of the reversing and doubling of the last-named bar) were effected while the iron was cold. The bars tied into knots repre-

sent the Earl of Dudley's treble best "cable" quality; and a ship riding at anchor with chains made of such iron would always be safe. Among other interesting objects in the case is a small chain twisted up to a tensile strain of 39 tons 14 cwts. per square inch, whilst reducing the area at the point of fracture 50 per cent. There is also a piece of 7 in. by 5 in. girder iron bent sideways of flanges until the two flanges meet together. The case itself is tastefully decorated, and over each section is the earl's coronet. Mr. R. Smith-Carson, the manager of the Round Oak Works, had the arrangement of the specimens. To him much credit is due for affording visitors to the Garden Palace an opportunity of judging of the iron from thes ecelebrated works. We are assured that every sample shown has not been specially manufactured for the Exhibition, but selected from orders being executed at the works at the time they were required. Every sample is branded with its distinctive brand. Altogether these exhibits are most interesting, and show to what points our ironmasters must specially give their attention.

Turning from the useful to the ornamental, attention should first be directed to the electrotypes of the Queen's plate. Contained in two glass cases, and placed under the northern side of the dome, are the electrotypes of the Windsor plate, which have been lent to the International by Her Majesty the Queen, and sent to the colony by the authorities of the Kensington Museum. These exhibits attract much attention from visitors. In one case is a silver gilt christening font, dated 1660, engraved with the crown and cipher of Charles II., the design being figures of cherubs amidst fruit and flowers. On the summit of the font is the figure of a priest in the act of baptising. Next is a silver gilt salver designed by Thomas Stothard, R.A., and made by Messrs. Rundell and Bridge for the Prince Regent (George IV.) in 1814, it being in the form of a triumphal car. A second (silver gilt) salver is dated 1690, and bears on it the cyphers of William III. and Mary, together with a representation of the Lord's Supper. A wine fountain is a magnificent work of art. It is also in silver gilt, and on each spout is a figure holding it, with representations of sea shells to catch the overflowing liquor, which flows into the basin below, where are sea monsters and mermaids at play. A tankard is dated 1690, and bears on it the cyphers of William 111. and Mary. Anne Boleyn's sceptre, a rod and crucifix of ivory, ornamented with enamelled gold, is said to have been made for the Queen of James I., although named after one of the wives of Henry VIII. A cup and wine cooler designed by the celebrated English sculptor, John Flaxman, in 1817, are objects of much interest. The ornamentation is in Grecian style of hammered work. There are leaves and bunches of grapes, with a bordering of leaves of honeysuckle. On the top shelf of the case is a large centrepiece of silver gilt, bearing date 1750, and made for Prince Frederick, father of George III. It is supported by lions and unicorns, between which are slung hammocks containing sea shells, and over the basin is an open canopy with sticks on the upper portion for holding candles. An elephant, with a mahout seated on its neck, and ridden by an Indian god, is a very choice work of art. In the other case are two copies of solid silver tables, one bearing date 1700, with the arms of William III. richly chased. In the centre, which is oval, are the Royal arms, with crown, lion, and unicorn; and surrounding are four shields bearing the rose, thistle, harp, and the Prince of Wales's feathers. The other table bears date 1670, with the monogram of Charles II. The chasing on the top is of leaves and fruits. There is also a silver gilt fire dog, bearing the monogram of Charles II., and the arms of the Prince Regent (George IV.) The collection is altogether a most interesting one, and is worthy the study of all lovers of art.

The safety of railway travellers is now so well understood to depend upon the reliability of the signalling arrangements that this notice may well be concluded by a statement of the interesting apparatus shown by Messrs. M'Kenzie and Holland, the railway-signal engineers of Worcester, England, and is a full sized patent interlocking apparatus for signalling and interlocking a railway junction of two double lines, with all necessary gear for working and controlling the points and signals either from a cabin or the platform by one man. The specialty of this patent appliance is that by an ingenious arrangement of machinery the levers whereby the points and signals are worked or actuated on railways are so interlocked as to prevent the possibility of any state of conflict being brought about by either being antagonistic, thereby preventing accidents to trains from this cause, besides the great advantage of concentrating all the working and controlling under the charge of the signalman in the cabin. This invention of Messrs. M'Kenzie and Holland is very largely in use upon all the principal railways of the United Kingdom, and notably on the Great Eastern Railway at the Liverpool-street Station City Terminus, London, and Metropolitan Extensions; the Great Northern Railway—Finsbury and King's Cross Terminus, London; the North London Railway—Broad-street City Terminus; the Metropolitan Railway—Bishopsgate-street; the North-Eastern Railway—the station at Leeds; the Great-Western Railway—Cardiff large new station at York; the London and North-Western and North-Eastern joint railways—the new station, Worcester Station, &c. This system of interlocking is in full use at the terminus of the Victorian Railways, Melbourne, and also at other stations and junctions of the same railway. There is also a model of a railway station with siding and level crossing, with all the necessary signals, points, and level crossing gates connected up to M'Kenzie and Holland's patent interlocking apparatus, and worked and controlled therefrom. This concentrates the working of railway points and signals, and brings all under the control of the signalman in the cabin, the arrangements of the machinery being such as to prevent any possible conflict between points and signals, so that accidents to trains from this cause are entirely prevented. Wilson's patent piston and rings, manufactured exclusively by M'Kenzie and Holland, engineers, Worcester, are likewise exhibited. These pistons and rings for lightness, economy, and simplicity are strongly recommended, and are used largely in all kinds of high-pressure engines, steam hammers, &c. His Excellency the Governor and his Worship the Mayor of Sydney made a full inspection of these exhibits, and the whole system was fully explained by Mr. W. Griffiths, the agent for the patentees, who is most anxious to make the public fully acquainted with the system.

Steel—The Metal of the Future.—"L'Engineur" has addressed the following letter to the Cambrian:—"Sir, among the engineering exhibits at the late International Exhibition at Kilburn one of the most interesting alike to the metallurgist and the machinist was a collection of steel castings produced at Newburn-on-Tyne by Messrs. John Spencer and Sons. As illustrative of the various applications of steel to the purposes of machinery this extensive collection was most instructive, especially at the present time when steel is daily asserting its claim to be considered "the metal of the future," and when the demand is increasing for machinery at once light and strong, and capable of resisting a great amount of wear and tear. The articles exhibited by Messrs. Spencer were of the most varied form and application, including spur-wheels, pinions, and geared-wheels of all kinds, rings of gear and winding drums for traction and steam ploughs, wheels and sheeves for collieries, mines, &c., solid disc wagon wheels for railways, crank axles, brackets, rollers, clutches, axle boxes, hydraulic cylinders, together with a great variety of engineering castings, projectiles, &c., the specimens shown varying in weight from 10 lb. to 30 cwt. All the castings displayed remarkable soundness, those made from the steel of the milder qualities possessing a very great degree of toughness, some of the test pieces being capable of bearing a tensile strain of 30 tons per square inch of sectional area, with an elongation of 25 per cent. before fracture. Such a material is well suited for any work having to sustain sudden and varying strain, or where a high degree of ductility is required. The qualities which stand a tensile strain of from 40 to 50 tons per square inch of sectional area, with an elongation varying from 15 to 3 per cent., are applicable to various uses, according as greater resistance to abrasion or more or less ductility is required. It is the remarkable capability which steel possesses of being thus varied in toughness and hardness which constitutes the immense value of that metal to the engineer and machinist, and which has already caused it to displace cast-iron in so many constructions. Messrs. Spencer's exhibits serve in an admirable manner to demonstrate the capabilities of cast-steel, and promise well for the future development of this important branch of manufacture. The writer may state that he has seen tests of the plates made by the Swansea Siemens, Landore, which equal, if they do not surpass, any for boiler construction and shipbuilding. The qualities of this steel only require to be known when it will be appreciated by the bridge and girder, boiler and ship, engineers of the world."

INCREASED MAKE FROM BLAST-FURNACES.*

BY J. WOLTERS.

The best practical means of economically obtaining a large make from blast-furnaces, without impairing the quality of the iron produced, are investigated in detail and at considerable length by Mr. J. Wolters, engineer of the Providence Ironworks at Marchienne-au-Pont, near Charleroi, Belgium; and the principal conclusions at which he arrives, from the recognised data furnished by modern blast-furnace practice, are summarised by himself to the following effect:—

1.—An ample supply of blast must be available of suitable pressure. The power of the blowing-engines required will be determined in each individual instance according to the consumption of fuel in the furnace per ton of iron made and the pressure of blast employed. Even with the best blowing-engines the useful effect obtained in the blast issuing from the tuyere nozzles cannot be taken at more than about half the steam power expended.

2.—The height of furnace that is most advantageous in any individual case can be determined by trial only. In coke furnaces it depends essentially on the nature and composition of the ores treated; where their reduction does not present more than average difficulty the height should range generally from 50 to 80 ft. in order that the zone of reduction may extend through a sufficient height, and that the temperature of the escaping gases at the furnace top may not exceed about 400° Fahr. Very hot blast obviates the need of so great a height of furnace as where cold blast or only moderately heated blast is used; but this is not so in treating ores that can be smelted with a comparatively small quantity of fuel, in which case the consequent smaller supply of carbonic oxide renders a greater height desirable for prolonging the exposure of the ore to the reducing action of the gas so as to make up the weekly make. A great height of furnace is not to itself disadvantageous; the question is mainly whether increased capital outlay is compensated by economy in working.

3.—The diameter of the body of the furnace should be made as large as possible, provided that the current of the ascending gases be not thereby so irregularly distributed throughout the horizontal area of the furnace as to diminish the ratio which the weekly make bears to the furnace capacity. For ores that smelt with average facility the diameter at the boshes should be between 18 and 20 ft.; it should not exceed the latter, otherwise the increase of weekly make will be relatively less than that of furnace capacity, and will be counterbalanced by the increase in first cost and by the greater difficulty of working the furnace. An angle of about 70° is found to be the best for the slope of the boshes in smelting average ores that have no tendency to scaffold. The height from the floor of the hearth to the top of the boshes should be about one-third of the total height of furnace.

4.—The furnace mouth should be made large, but its diameter should not exceed two-thirds of that at the boshes so as to preserve such an inclination of the furnace sides as will diminish the friction of the materials against the refractory lining, and thus facilitate the regular descent of the charge. With a mouth of 11½ to 13 ft. diameter the method of charging the materials and of taking off the gas must be so arranged as to ensure the gas passing up very freely through the centre of the furnace, which is particularly important in dealing with refractory ores.

5.—The size of the hearth must be proportional to the make, and large enough to require tapping only once in every 12 hours. The diameter at the level of the tuyeres must increase in a certain ratio with the capacity of the furnace, otherwise the furnace cannot be made to drive fast enough without an excess of blast, which will burn the iron. In general the diameter at the tuyeres should not exceed 6 ft.; it may be increased even up to 8 ft., where the hearth would otherwise be too small to hold only 8 hours' make, but the larger diameter involves extra consumption of fuel, and interferes to a certain extent with the regularity of working. So far as may be compatible with the character of the ore and with the intended quality of pig, the boshes should start as close as possible to the tuyers level, with the least possible height of breast above the tuyeres.

6.—The internal profile of the furnace should present no angles which can interfere with the regular descent of the materials. Valuable practical hints on this point are obtained by examining blown-out furnaces.

7.—The hotter the blast the greater is the economy of working—that is, the greater is the weekly make, and the less the consumption of fuel. Where the pig is intended for the finery its commercial value is not impaired by the proportion of impurities it may retain when smelted from ores of middling quality; but for foundry iron, smelted from ores of even ordinary quality, it must not be forgotten that the hotter blast renders the iron more brittle. As the effect of the temperature of the blast upon the quality of the iron depends most of all upon the nature of the materials treated, care must be taken to ascertain the best temperature in each individual instance. With too hot a blast the deterioration in quality will outweigh the diminution in the cost of making the iron. For smelting ores of very good quality to obtain a high class of pig, such as is required for the manufacture of artillery, cold blast should be used, or at any rate, blast only slightly heated.

8.—The mode of taking off the gases and of charging the materials depends on the size of furnace month and the character of the ore. With a large mouth and a more or less refractory ore the ascent of the gas requires to be facilitated through the materials in the centre of the furnace, which descend with greater rapidity and have less gas passing up through them than those round the sides of the furnace. That object will be accomplished by taking off the gas at the centre of the furnace, and charging the materials in such a way that the bigger lumps of ore and fuel shall roll into the centre. In all cases it is best not to deliver the charge close up against the sides of the furnace, but at some distance from them. The filling must be done with great regularity, and it is recommended that the fuel should be charged by bulk and the ore by weight. The most convenient size of charge will depend upon the diameter of the furnace mouth, the mode of filling adopted, and the nature of the materials. In open-topped as well as in close-topped furnaces the pipes for taking off the gas should be large, and a good chimney draught should be employed. The gas should be taken off separately from the centre and from the sides of the furnaces; that from the centre to be used for the boilers, and that from the sides for the hot-blast stoves.

9.—Constant watchfulness is required on the part of the blast-furnace manager to ensure the supply of heat in the furnace being maintained equal to the heat absorbed. He should, therefore, by the aid of chemical analysis keep himself perfectly acquainted with the composition of the zone of fusion. At each casting time he should examine the tuyeres to see that they are properly placed and kept in good working order; tuyeres of gun metal or wrought copper are to be preferred. The pressure and quantity of the blast should be attended to, as also the quality of the coal from which the coke is made, and the process of coking. The flame from the furnace top, the working of the tuyeres, and most of all, the nature of the slag, give the best practical indications as to the working of blast-furnaces.

10.—When wlth a given temperature of blast the minimum consumption of fuel has been ascertained—so that any increase or diminution in the speed of driving would necessitate a larger consumption for producing the same quality of iron—there is a positive advantage in increasing up to a certain point the speed of driving, even though, owing to the increased consumption of fuel, the margin of profit per ton of pig is thereby diminished; this is assuming that there is no question of interest on stocks of pig in hand, but that the iron is sold as fast as made. The most advantageous speed of driving can be calculated for each individual case.

11.—In conclusion, it is of the utmost importance that blast-furnace managers, besides being men of great practical ability, should also possess the scientific knowledge requisite for enabling them to follow the various processes taking place on so large a scale within the furnace; in this, more than in any other branch of the metallurgy of iron, progress is impossible without such knowledge.

* Abstract of a paper in Revue Universelle des Mines, Vol. IV., p. 123. From the proceedings of the Institution of Civil Engineers of London, edited by James Forrest, Secretary.

FIELD GEOLOGY.

The second edition of Mr. Penning's valuable Text-book of Field Geology,* has just been issued, with an additional section on palæontology, by Mr. Jukes-Browne. As both of the authors are members of the Government Geological Survey, they have, of course, had facilities for observation and experience which would scarcely be expected from non-official geologists; and the volume shows that they have spared no pains to make their knowledge useful to those who choose to study. They remark that the objects primarily aimed at have been to include such instructions as are essential to the working out, either for scientific or practical purposes, of the geology of the district by the determination of its rocks, their extent, relation, comparative age, and economic productions, whilst excluding all descriptions and explanations of the principles of geology, which would be out of place in a field guide. The text-book is judiciously divided so as to deal with geological surveying, geological sections, lithology (determination of rocks), and palæontology (determination of fossils), the directions given in each part being simple and elementary, assuming the student to possess a fair book knowledge of the science, of its principles, of the sequence of the various systems, formations, and groups, and of the general succession and range of fossil plants and animals.

The section treating of geological surveying the selection of maps. the use of contour maps, compass, and protractor, scales, &c., are carefully referred to, and the method of tracing boundary lines is carefully described. In explaining when and why the boundary lines coincide with the contour, the author gives three rules which afford material assistance. 1. The boundary lines of horizontal strata exactly coincide with the contour, however uneven the surface of the ground may be at the outcrop.—2. The boundary lines dipping towards a hill are less winding than the contour, for if the dip were gradually increased until the strata became vertical, the lines of division would gradually approach and finally become parallel straight lines, consequently as the dip is into a hill so the line varies from the contour towards a straight line.—3. The boundary lines of strata dipping from a hill are more winding than the contours, for were the dip increased until exactly equal to that of the surface slope, the planes of division would continue beneath the surface, and unless the slope increased, could not possibly form a line of boundary. But the rule is true to this point only, for when the slip exceeds that of the slope in the same direction, the boundary lines wind in a reverse way to the contours, and also begin to draw in towards a straight line as the amount of dip is increased. Strata sometimes occur in a horizontal position; much more frequently the strata dips towards the higher ground, from beneath which they have risen to the surface, and it is an exceptional occurrence for strata at their outcrop to dip with the slope of the ground. As examples are given of actual observations, and the method of recording them, the reader can readily form an accurate idea of what has to be done and how to do it.

The making of sections is dealt with in the next part, and there is an ingenious table for obtaining approximate results almost as quickly as accuracy can be obtained by the usual methods. The table shows for each degree the cotangent of angle of dip, the approximate proportionate incline, the yards rise or fall in one mile up to 14°, the depth from surface in a distance of 100, and the thickness of the beds at right angles. If a table of any kind is required there is obviously an advantage in carrying one that will give exact results instead of approximations only. The third part, which treats of lithology, contains an enormous amount of information condensed into the smallest possible space, and contains quite as much as the ordinary field geologist is likely to require for reference. The Palæontological Section contributed by Mr. Jukes-Browne is very complete, containing a good outline of the nature of fossil remains, a review of the animal kingdom, remarks on the petrifaction and preservation of fossils, casts and impressions, and distortion of fossils. There is a chapter on how to collect fossils, which will be found very useful, and another on the preparation of fossils for scientific use. The succeeding chapter explains the nature and value of palæontological evidence, and there are also given some very useful tables.

The concluding part treating of the scientific and practical results is, perhaps, the most important in the volume, since it offers suggestions to the student, points out the importance of accuracy, and describes the difficulties in certain cases which have to be met. The edition is considerably more comprehensive than its predecessor, and in its present form there is really little which requires further emendation. It is likely to become generally recognised as what it claims to be—a text book for field geologists, and well deserves that recognition.

* A Text-Book of Field Geology. By W. H. Penning, F.G.S. With a Section on Palæontology. By A. J. Jukes-Browne, B.A., F.G.S. Second Edition, revised and enlarged. London: Ballière, Tindall, and Cox, King William-street, Strand.

APPARATUS FOR BURNING LIQUID FUEL.

An ingenious and economic method of burning liquid fuel for heating purposes has been invented by Messrs. Burbank and Sprague, of Rochester, New York. At one end of the platform or tray, which sustains the parts, is an inverted fountain for containing the oil, the neck of which fountain rests in an open-topped vessel and is provided with a valve which allows the oil to escape in a manner similar to that in the well-known German student's lamp. From the bottom of the vessel extends a pipe for conveying the oil to the burner. Connected with the said pipe is a lamp body, on the upper part of which is a cap containing wick-tubes, and which may be protected by plaster of Paris or other non-conductor of heat. Over the lamp body rests a casting formiug a bearing which is secured removably to the lamp body by a set screw. Within the bearing there is a wire screen for breaking the currents of air, and above said screen a deflector plate with deflectors which rest over the burners. On top of the bearing rests a cylinder forming a chimney or heat conductor, and in the open top of this cylinder rests a small steam boiler, which receives its heat from the burners below. The boiler has a series of pipes outside which open at the top and bottom into the boiler, and thereby assist the generation of steam by circulating the water. At the top of the boiler is a safety valve which will open and allow escape of the steam when a certain pressure is attained. From the top of the boiler above the water line extends a steam pipe which passes around the boiler and beneath the same above the burners, and thence extends outward to the proper point to act upon the oil In this steam pipe outside the cylinder there is a cock or cut-off by which the steam may be turned on or cut off and regulated at pleasure. At the outer end of the steam pipe is a small nozzle having a fine orifice which forms an injector.

At the opposite end of the platform from the inverted oil fountain is a combustion chamber resting on legs. This chamber may be of any desired form, and used for various heating or cooking purposes. From the bottom of the combustion chamber extends a tube or funnel, the outer end being closed, excepting that there is a hole in the centre surrounded by a series of holes outside. Beneath the combustion chamber is a reflecting plate to prevent the passage of heat to the platform. Between the combustion chamber and the burner is an oil fount, which communicates with the main oil fount by a pipe, or it may be separate. From this oil fount a tube extends upward, and has on its upper end a small nozzle similar to that on the end of the steam-pipe. The ends of these two nozzles come into coincidence, so that the steam-pipe blows across the oil nozzle, and forces the atomised spray through the tube before described into the combustion chamber, where it is ignited and burnt. The two nozzles form an atomiser that draws up the oil by suction, and forces it into the combustion chamber. The inverted oil fount and the cylinder and boiler are mounted on a separate piece that forms a carriage, and the carriage moves forward and back in ways on the platform, so as always to keep the atomiser in line with the tube entering the

combustion chamber. In the combustion chamber is a heat deflector for confining the flame and forcing the same downward and causing it to spread outward. The top of the combustion chamber is perforated to produce a draught, and the bottom has openings to allow the entrance of fresh air. If desired two steam pipes instead of one may lead from the boiler for injecting the oil into the combustion chamber, so that if one should fail at any time the other would be effective.

PURE CRYSTALLINE FORMS OF CARBON.

After 13 years of experiment, Mr. James Mactear, of the St. Rollox Chemical Works, Glasgow, has succeeded in obtaining "pure crystalline forms of carbon," which, it appears, Prof. Tyndall, Prof. Smyth, and Mr. Maskelyne, of the British Museum, do not doubt to be true diamonds. Even when the results are from an economic aspect inconsiderable, the artificial formation of any substance hitherto known solely as a natural product must always be regarded as a great triumph in organic chemistry. In the laboratory the marvellous chemical discoveries of recent years have in a great measure reduced the production of diamonds to a question of time and patient experiment, but the general certainty of ultimate success does not in any way detract from Mr. Mactear's brilliant discovery in synthetical mineralogy. He is rather to be congratulated on his indubitable claim to priority, for the dual discovery of the planet Neptune, of the metal thallium, of liquid oxygen, and a number of other curious coincidences in the history of scientific research, suggest the possibility, if not the probability, of other alchemists testing with half incredulous delight the tiny crystals which they almost tremble to identify with the natural gem. Chemistry has so widened belief in the magic of the laboratory that antique impossibilities have become modern difficulties, and the synthesis of the diamond in particular seems a feat which one would be justified in regarding as likely enough. Eleven years ago two German chemists produced from gas tar the colouring principle of madder, and the Turkey red which we formerly obtained from the fields of France, Holland, and the Levant we now order from the chemical factory Last year Prof. Baeyer, of Munich University, succeeded in building up the blue colouring matter of indigo from the comparatively common substance known as phenylacetic acid, and the scientific triumph is none the less because there appears no present hope of artificial indigo taking the place of the vegetable dye. In the previous year, 1877, oxygen, nitrogen, hydrogen, and other so-called permanent gases were liquified; the very air we breathe was condensed to a liquid jet; hydrogen was shown to be the vapour of a metal and water a true metallic oxide; and the imagination was enabled to add to the terrible picture of a sunless world, with its rivers of ice and its petrified seas, an atmosphere turning, in a state of disintegration, from invisible gases to strange liquids and new metals. The production of artificial, not imitation, rubies in the same year by MM. Fremy and Fell seemed especially to herald the production of the diamond. Of all precious stones the ruby is the most valuable. When even of only a moderate size a diamond of equal weight is but one-tenth its worth. Chemically it is pure alumina—the oxide of aluminium, which enters largely into the composition of ordinary clay. Such an aluminate as that of lead when heated with siliceous or flinty matter, gives a fused mass, from which on cooling free alumina separates in crystalline forms—true rubies, if the chemist shall have added a small proportion of bichromate of potassium, true sapphires, if a trace of the bichromate and a little oxide of cobalt. In specific gavity and in the system of crystallisation the artificial stone and the ruby are identical; they differ in nowise, unless, indeed, it be a fact that the lapidary has found the hardness of the artificial to excel that of the natural gem. We are not aware of the process by which Mr. Mactear has produced his diamond crystals, and though up to the present they have stood the test of acids, alkalis, and the blowpipe, their hardness, refractive index, measurement of angle, and, we presume, their density, have yet to be established as identical with those of the diamond in nature.

It need hardly be added that it will be a source of general gratification if these latter results can be obtained, and they will be waited for with eagerness. Diamonds have from time immemorial fascinated the popular imagination. The fairyland of the nursery glitters with diamonds, and the heaven of mature belief can only be pictured to the vision by the colour and brilliancy of jewels. Medicine of old found its panacea in gems, and the search for the philosopher's stone was the genesis of chemistry. In Pliny's days the six varieties of diamonds were solely in the possession of the most luxurious kings, and royalty has amassed them ever since. The spots where they have been found have been the goals of human desire and the theatres of human passion, suffering, and crime. Through centuries of history a handful of them have outshone the memorable eyes of beautiful women and the swords of a thousand heroes. The Six Paragons are more famous than the Seven Champions of Christendom, and their romances are more enthralling than Wilkie Collins'. The Orloff diamond in the Czar's sceptre was the eye of an Indian idol; the Florentine was lost by Charles the Rash on the ill-fated field of Granson, and was sold for a few pence by a Swiss soldier who found it; our own Koh-i-noor was reputedly worn 5000 years ago by the hero of the Hindoo epic, the "Mahabharata," and at a later period was wrested from the Khan of Cabul by Runjeet Singh, who decked his horse with it on high festivals. For the great diamond of the Rajah of Mattan, in Borneo, \$150,000, two large war brigs, and a complete store of arms and ammunition were refused. A large diamond, supposed to be part of a huge gem of which the Orloff and Koh-i-noor are fragments, was found in the hands of a peasant who used it as a flint to light his fire. The first Brazilian diamonds were, in 1727, recognised among negroes, who used them as counters in card-playing; and the first Cape diamond, given to a Scotch farmer in 1867, and sold at the Paris Exhibition for 500*l.* was the plaything of a Boer's children.

In all the great geographical divisions diamonds have been discovered, but the European specimens are few and small. Only about 70 were gathered in 20 years in the gold washings near the iron mines of Bissersk, at the foot of the Ural Mountains; and Dlaschkowitz in Bohemia is notable for a solitary gem. None have been found elsewhere in Europe. The occurrence of the diamond in mica slate and in or near igneous rocks, and especially in the "pans" or "pipes" at the Cape, favours the view that it owes its origin to heat or metamorphic action, and that it has been brought to the surface with volcanic matter. Newton considered it "an unctuous substance coagulated;" Jameson, the secretion of an ancient tree, like amber; Brewster traced it to a vegetable source; in 1842, Petzhold stated that in its ashes he had discovered traces of plant tissues and vegetable cells; while Liebig and others believed it was formed by a slow process of decomposition in a fluid rich in carbon and hydrogen. Its inflammable nature was conjectured as early as the 16th century, and was proved at Florence in 1694. Lavoisier determined the product of combustion to be carbonic acid gas, and by the aid of the "pure crystallized carbon," Sir George Mackenzie, in the most expensive process on record, converted iron into steel. Analysis of a substance which, when the air is excluded, resists the maximum heat of a porcelain kiln and the temperature at which pig-iron melts, can be conceived to have presented considerable difficulties; but with diamonds, as with our neighbour's character, it is easier to pull to pieces than to put together again. Synthesis is a triumph of an infinitely higher order. However, even if Mr. Mactear's experiments have solved the puzzle of mediæval alchemy, it remains yet to be proved whether in a commercial sense they can have much influence on the value of the natural diamond. It is the peculiar interest in the laboratory ruby that the gem has been prepared in such quantity as to be available in the arts. The glass furnace, it is stated, has yielded "a crystalline mass (of ruby) weighing several kilogs." Mr. Mactear's crystals measure but 1-32nd of 1 in. Future experiments under improved conditions may, indeed, produce crystals of sufficient magnitude to supersede the natural diamond in various of its technical uses, it may even involve a huge commercial catastrophe and manifold domestic tragedies; but until such an experiment has been successfully wrought out it is not likely that the panic of 1733 will fall on the jewellers of 1879. In any case, invention will never vulgarise the historic jewels of empires and the heirlooms of great houses.

—*Glasgow Herald.*

NEW HAND ROCK-DRILL.

Some important improvements in connection with apparatus for drilling or cutting rock have been invented by Mr. J. K. Gulland, of Westminster, engineer to the Diamond Drill Company (Thomas Docwra and Son). One part of the invention consists in an improved construction of boring or drilling machine (worked by manual or other power), in which the boring rod or drill bar is supported in bearings, one of which is movable on a bed or frame, and is operated from the boring rod or drill bar by spur gear, a worm and worm wheel, and a pinion taking into a rack so as to feed the drill forward as the boring or drilling proceeds. The worm wheel and the pinion that gears with the rack are arranged on the same axis or shaft, which has a conical or tapered part on which the worm wheel (correspondingly bored) fits, and may be tightened by a nut or equivalent means, or released so as to allow the axis or shaft to rotate independently of the worm wheel. Thus by turning in a reverse direction the axis or shaft by a handle or otherwise, the pinion gearing in the rack will cause the drill to be drawn back, and afterwards be readily returned into the hole. Between a part or enlargement of the boring rod or drill bar and the end of the bearing which takes the thrust friction, washers or rings are or may be interposed. The boring rod or drill bar is hollow or tubular, and is furnished with a water supply pipe to cool the drill and wash away detritus or debris. The water is supplied by a suitable pump, which in one arrangement is a pipe or tube of pliable material, communicating at one end with the water supply pipe of the drill, and at the other with some source of water supply. This pliable pipe or tube is suitably arranged in relation to a revolving frame carrying wheels or rollers, and to a concentric arc or path between which and the wheels or rollers the pliable pipe or tube is squeezed so as to act as a pump. The hand or driving wheel, revolving frame, and a suitable pulley, designed to drive boring rod or drill bar through a band or chain; another pulley; a counter shaft, and spur gear may be arranged on a common axis carried by a frame or bar, adjustable radially on a concentric boss surrounding the counter shaft, so that the said frame or arm may be swivelled into any convenient radial direction, and there fixed by suitable bolts; or the counter shaft may be driven in a direct manner. For undercutting, widening, or enlarging wells, holes, or borings for lining or blasting purposes, he uses a hollow or tubular apparatus provided with a suitable water supply, perforated to allow some of the water to escape (to cool the cutters and wash away detritus or debris), and having slots or openings furnished with parts resembling latches. These latch-like parts or devices are armed or furnished with diamonds; or other cutters are hinged, pivotted, or hung on hinges, pivots, or pins, and arranged so that by pressure of the water in the hollow or tubular apparatus they may be forced outward in such a manner as that those parts furnished with diamonds or cutters shall protrude through the slots, and the apparatus being rotated or revolved shall cut the rock or other substance forming the wall of the hole containing the apparatus; but when the water pressure is removed the said latch-like cutting devices will be drawn inward, and retained within the tubular apparatus by suitable springs or equivalent means provided for the purpose. This part of the invention may, of course, be carried out in various forms without departure from its characteristics features.

MANUFACTURE AND MELTING OF IRON AND STEEL.

In the ordinary method of manufacturing iron the blast-furnace in which the iron ore is reduced is urged by a blast of atmospheric air. A blast of atmospheric air is also employed in the treating of iron by the Bessemer process for the production of steel, as well as in cupolas and refineries in which iron is melted for casting and for refining. The blast employed is drawn direct from the atmosphere, and contains a greater or less amount of the vapour of water varying with the hygrometrical condition of the atmosphere from time to time. This vapour of water undergoes decomposition in the furnace, causing an absorption and loss of heat therein, varying from time to time in proportion to the greater or less amount of vapour thus introduced into the blast. The hydrogen evolved by the decomposition referred to gives a porosity to the iron or steel under treatment which is very injurious in castings.

In order to prevent the loss of heat referred to, and thus to economise the fuel employed and promote rapidity of fusion and a regular working of the furnace, and also to prevent to a greater or less extent the porosity produced in the iron or steel made or melted with air containing vapour of water, Mr. W. H. Fryer, M.E., of Coleford, Forest of Dean, proposes the desiccation of the blast. He passes the air to be forced into the furnace, cupola, or refinery, or Bessemer convertor, through or over sulphuric acid, or chloride of calcium, or other desiccating material, so as to deprive the said air wholly or in great part of the vapour of water contained in it. The desiccating material may be disposed in various ways in a chamber or receptacle through which the air is passed, the particular arrangement depending upon the nature of the material employed (whether solid or liquid) and its desiccating and other properties, the essential conditions of the arrangement of the said material and chamber or receptacle being that the desiccating material shall expose a larger surface to the air, and that the capacity of the chamber or receptacle shall be such that the air will travel through it at a sufficiently slow rate to ensure the thorough action of the desiccating material upon it. The desiccating material may be either supplied continuously or renewed from time to time as occasion requires, the particular arrangement for supplying and renewing the same depending upon the nature of the material (whether solid or liquid) and its desiccating and other properties, and the mode of restoring its efficiency when lost by use. Although the invention is principally applicable to furnaces used in the manufacture of iron and steel, and through which air is urged by a blast, yet it may also be applied to furnaces through which the current of air for maintaining combustion is drawn by an exhaustion, whether the said exhaustion be produced by a steam or other motive power engine, or by the draught of the heated and rarefied air in the chimney stack.

Tramways.—The improved tramway invented by Mr. James Kerr, of Glasgow, is made of steel or wought-iron by rolling; and one modification is in cross-section of a form having at the top the tread or wheel-bearing surface the usual groove, and the guard or inner rib, whilst at the sides there are deep webs having horizontal or nearly horizontal base flanges or webs projecting outwards along their bottom edges. The side webs may be vertical, or they may be slightly inclined so as to be wider apart at their bottoms; and they may be straight or more or less curved, a curvature giving a wide base being in some cases adopted instead of base flanges. Openings may be formed through the side webs or base webs or both for introducing cement or packing material. The side webs are made deep enough to admit of the paving-stones being placed close to them and above the base webs. The rails are to be laid upon concrete or other suitable foundation; and concrete or other cement or packing material may be filled in between the side webs and to a limited depth above the base webs. The length of rail may be connected together by ordinary fish-plates or by means of joint shoe-plates, the latter consisting each of a plate extending a sufficient distance beneath the adjacent rail ends at a joint, and having its lateral edges turned over to clip the base webs or flanges of the rails. Or instead of a single shoe plate at each joint, there may be a pair of clip plates secured along each side. The groove along the top of the rail may be varied in section or form to suit different forms of wheel tire, including a shallow concavity of the full width of the rail or nearly so, also a shallow concavity with a small deeper groove along the middle of it, and also a flat top with a small groove along the middle of it. The groove may be formed or partly formed in the rolling process, or it may be formed or finished by subsequently planing it; and the rail may be rolled at once with the side webs and base webs in their final positions relatively to the to or the side webs or base webs, or both may be brought to their finished forms subsequently.

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POSSIBLE